The vacuum between the jacket and the mass would act as an efficient non-conductor of heat.

We may, however, probably conclude with considerable certainty on the combined testimony of the two series of experiments that, within the limits of temperature used, no variation of weight occurs greater than 1 part in 10^8 for a rise in temperature of 1° C.

Note on the Continuous Rays observed in the Spark Spectra of Metalloids and some Metals.

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In a paper published in the 'Proceedings of the Royal Society,'* reasons were given for believing that the back-ground of continuous rays in the spark spectra of the metalloids, for instance, tellurium, arsenic, antimony, and bismuth, was caused by the light emitted by an incandescent oxide, whether in a state of vapour or solid, having its origin in the cooling of the dense vapour of the element in an atmosphere containing oxygen. The spectra of metals which are not oxidisable did not show it, namely, gold, silver, and platinum, neither did those of the easily volatile metals such as mercury, indium,† thallium, zinc, and cadmium. It was visible on photographed spectra of metals belonging to the iron group, but at the points of the electrodes only, where a non-volatile oxide is formed.

As the original explanation has not been accepted as satisfactory‡ I have recently submitted the question to a special examination.

It must not be overlooked that spark spectra with continuous rays are yielded by the metals lead, tin, and cadmium, if the exposure of the photographic plate be increased to double that sufficing for the line spectra, and that sparks passing between electrodes of these metals in air deposit their oxides on all objects near to them; in hydrogen, films of metal are deposited on the walls of the containing vessel, and when air is substituted for hydrogen there is at first a deposit of oxide, and subsequently one of

* Vol. 49, pp. 448—451, 1891.

† This word is misprinted "iridium" in the 'Proceedings.'

‡ See Kayser's 'Handbuch der Spectroscopie,' vol. 2, p. 286; also P. Lenard, 'Annalen der Physik,' 1905, vol. 17, pp. 208—212.

metal when the oxygen has been exhausted. In 1905, having again sought for the most convenient source of a continuous spectrum extending as far into the ultra-violet as wave-length 2144, the subject of the continuous rays was re-investigated by passing sparks between metallic electrodes in a closed vessel containing different gases. The conditions of the experiment, such as the size of the electrodes, the length of spark, and the period of exposure were identical for each gas and for each metal. The exposure was five minutes in a spectrograph with quartz lenses of 20 inches focus, and Cadett and Neall's spectrum plates developed with ferrous oxalate. The spectra were taken, one below the other, on the same plate, and close together so that they could be easily compared. The results shortly are as follows:—The emissive power of *cadmium*, as measured by its action on a photographic plate, stands first in hydrogen, second in nitrogen, third in air, and fourth, weak in carbon dioxide. This order applies particularly to the lines, but if we consider the continuous rays, the spectrum in hydrogen is the strongest, then those in nitrogen and air are about equal, but less strong than in hydrogen, the spectrum in carbon dioxide is very feeble. The result appears different when the electrodes are of *lead*. Thus the emission spectra both of lines and continuous rays are equal and very strong in hydrogen and nitrogen: they are equal, but very feeble, in carbon dioxide and air. The *tin* lines are a little stronger in nitrogen than in hydrogen, the continuous spectrum in both is strong and of equal intensity; the lines in carbon dioxide show less intensity, and the continuous spectrum is of about half the intensity of that in the hydrogen and nitrogen; in air the lines and the continuous rays are both enfeebled. In order to ascertain whether the metalloids give stronger spectra of continuous rays when they are exposed to the influence of hydrogen, arsenic and antimony were experimented upon. It is necessary to quote only the case of arsenic. It became of interest to ascertain whether by the action of the spark on this element in hydrogen a characteristic hydride could be obtained which would prove a delicate test for its presence. The results showed that the lines are very sharp and distinct in hydrogen while the continuous rays are feeble, but with air the lines are more feeble while the continuous rays are practically non-existent, or at most barely visible in any part of the spectrum. The result was similar with antimony. No evidence of any importance was obtained showing that the spectrum was other than that of arsenic or antimony as observed in the spectrum of air.

On reviewing the facts we see, *first*, that the nature of the gas surrounding the electrodes appears to have a distinct influence on the spectra; *secondly*, that it operates somewhat differently on different metals; *thirdly*, that the

continuous spectrum is not caused by oxidation, because in every case it is strongest when the electrodes are immersed in hydrogen or nitrogen. All the spectra are weakest in an atmosphere containing oxygen, whether free or combined, such as air or carbon dioxide, and the conclusion is inevitable that oxidation destroys or weakens the spectrum, for even in the carbon dioxide atmosphere the reversible interaction $CO_2 \rightleftarrows CO + O$ may liberate oxygen in greater quantity than that which is present in the same volume of atmospheric air. The continuous rays are clearly not due to the emissive power of any incandescent oxide, either gaseous or solid.

On the Use of Metallic Electrodes as a Source of Continuous Rays.—Particulars of trials made with various metallic electrodes were given on p. 473 of the 'Phil. Trans.,' Part II, 1885 ("Absorption Spectra of the Alkaloids,") and need not be recapitulated.

E. Pauer also experimented in the same manner 12 years afterwards and arrived at the same conclusion, namely, that the continuous rays of cadmium answered the purpose better than copper, iron, or nickel electrodes.*

At various times a number of flame spectra have been examined, as, for instance, those of sulphur and of phosphorus burning in oxygen, of carbon disulphide in nitrous oxide, phosphine in oxygen, ether and hydrogen with oxygen burnt from a blowpipe, also acetylene with oxygen burnt in the same manner. The inverted Welsbach incandescent gas-light used without a glass, the zirconia, magnesia, and lime lights have all been tried. Of the flame spectra the best effect is obtained with acetylene and oxygen, the rays are quite continuous and of equal intensity from the red to beyond wave-length 2700. There are some difficulties attending manipulation with flames, particularly on account of their great heating effect, and I have therefore returned to the use of the cadmium spark spectrum for special observations on the spectra of hydrocarbon vapours, with results that I propose to make the subject of another communication.

* 'Wiedemann's Ann.,' 1897, vol. 61, p. 363.